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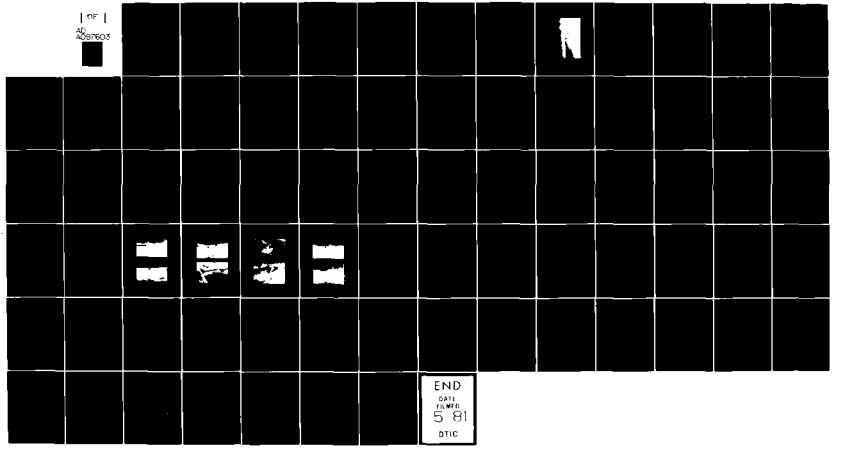

DELAWARE RIVER BASIN

LAKEVILLE CREEK, WAYNE COUNTY

PENNSYLVANIA

LAKE ELLYN DAM

NDI ID NO. PA-00138
DER ID NO. 64-32

ESTATE OF A. REINER

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DACW31-81-C-0018

Prepared by
GANNETT FLEMING CORDDRY AND CARPENTER, INC
Consulting Engineers
Harrisburg, Pennsylvania 17105

For
DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

JANUARY 1981

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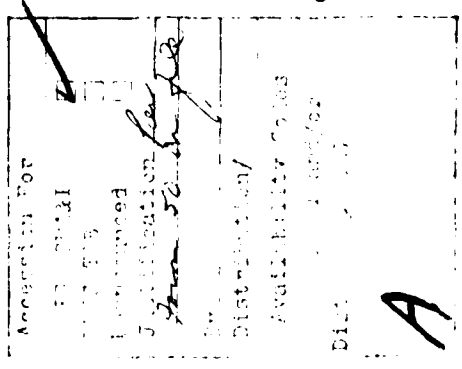
PREFACE

This report is prepared under guidance contained in Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.



LAKE ELLYN DAM

NDI ID No. PA-00138, DER ID No. 64-32

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

CONTENTS

APPENDICES

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITION

AND

RECOMMENDED ACTION

Name of Dam:	Lake Ellyn Dam NDI ID No. PA-00138 DER ID No. 64-32
Size:	Small (9 feet high; 228 acre-feet)
Hazard Classification:	High
Owner:	Estate of A. Reiner Martin Goodman, Executor 1315 Walnut Street Suite 1207 Philadelphia, PA 19107
State Located:	Pennsylvania
County Located:	Wayne
Stream:	Lakeville Creek
Date of Inspection:	28 October 1980

Based on available records, visual inspection, calculations, and past operational performance, Lake Ellyn Dam is judged to be unsafe, nonemergency, because the spillway capacity is rated as seriously inadequate. The recommended Spillway Design Flood (SDF) for the size and hazard classification of the dam varies between 1/2 of the Probable Maximum Flood (PMF) and the PMF. Based on the size of the dam, the 1/2 PMF is selected as the SDF. The existing spillway will pass only about 10 percent of the Probable Maximum Flood (PMF) before overtopping of the dam occurs. It is judged that the dam could not withstand the depth and duration of overtopping that would occur for the 1/2 PMF. Failure of the dam would cause an increased hazard for loss of life downstream. Overall, the dam is judged to be in poor condition.

Although records indicate that no serious structural failures have occurred in the past, they do indicate that the dam has been in poor condition since 1917. The dam has several

deficiencies including, depressions, settlement, erosion, seepage and trees growing out of walls. There is no assurance that potentially hazardous conditions do not exist.

There are no outlet works facilities at the dam.

Maintenance at the dam needs to be improved.

The following studies and remedial measures are recommended to be undertaken by the Owner, in approximate order of priority, immediately:

(1) Perform additional studies to more accurately ascertain the spillway capacity required for Lake Ellyn Dam as well as the nature and extent of measures required to provide adequate spillway capacity. Take appropriate action as required.

(2) Perform investigations as required to determine the lines, grades, and composition of the dam. After such a determination has been made, studies should be performed to assess the dam for any potentially hazardous conditions that might exist, including stability and seepage. Take appropriate action as required. Until action is taken, the depressions and low areas on the top of the dam should be filled and the embankment monitored. The collapsed sections of the downstream wall should also be monitored.

(3) **Develop** a suitable means of drawing down the reservoir in case of an emergency. Any pipe that is placed through the embankment should be provided with an upstream closure facility.

(4) Remove the trees from the downstream walls.

(5) Repair the eroded areas on the upstream slope and provide suitable erosion protection.

All investigations, studies, designs, and inspection of construction should be performed by a professional engineer experienced in the design and construction of dams. Tree removal should also be under the guidance of a professional engineer.

In addition, the Owner should institute the following operational and maintenance procedures:

(1) Develop a detailed emergency operation and warning system for Lake Ellyn Dam. When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system.

(2) During periods of unusually heavy rains, provide round-the-clock surveillance of the dam.

(3) Initiate an inspection program at the dam such that the dam is inspected on a regular basis. As presently required by the Commonwealth, the inspection program should include a formal annual inspection by a professional engineer experienced in the design and construction of dams. Utilize the inspection results to determine if remedial measures are necessary.

(4) Institute a maintenance program and develop a formal maintenance manual so that all features of the dam are properly maintained.

LAKE ELLYN DAM

Submitted by:

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.

FREDERICK FUTCHKO
Project Manager, Dam Section

Date: 9 February 1981

Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

Date: 11 March 81

LAKE ELOYN DAM

Overview

LAKE ELLYN DAM

NDI ID No. PA-00138, DER ID No. 64-32

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

SECTION 1

PROJECT INFORMATION

1.1 General.

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Lake Ellyn Dam consists of upstream and downstream dry stone masonry walls with a central earthfill section and a 13-foot wide broad crested spillway near the center of the dam. The overall length of the dam is 350 feet and the dam is about 9 feet high. The top width is about 12 feet on the section to the right of the spillway and about 16 feet on the section to the left of the spillway. Along part of the dam, the slope of the downstream dry stone masonry wall is nearly vertical with a bench about 3 feet below the top of dam. Along other parts of the dam, it is 1V on 1H resulting from failure of the near vertical wall and the placement of rockfill. The upstream slope was obscured by the reservoir and the slope could not be determined. A top of dam profile and typical cross sections are shown on Plate E-2.

The spillway is a concrete structure consisting of a slab and abutment walls, which form a broad-crested weir and channel across the top of the dam. The spillway is about 13 feet wide and discharges in a straight drop to the streambed at the downstream toe. The area below the spillway is partially covered with rock, floating timber, and other debris. The spillway crest is about 2 feet below the abutment walls and 1.7 feet below the lowest top of dam elevation.

There are no outlet works facilities for Lake Ellyn Dam.

The various features of the dam are shown on the photographs in Appendix C and on the Plates in Appendix E. A description of the geology is included in Appendix F.

b. Location. Lake Ellyn Dam is located about 2 miles west of Lakeville on Lakeville Creek in Lake Township, Wayne County, Pennsylvania. Lake Ellyn Dam is shown on USGS Quadrangle, Lakeville, Pennsylvania, at latitude N 41° 26' 30" and longitude W 75° 19' 00". A location map is shown on Plate E-1.

c. Size Classification. Small (9 feet high, 228 acre-feet).

d. Hazard Classification. High hazard. Downstream conditions indicate that a high hazard classification is warranted for Lake Ellyn Dam (Paragraphs 3.1e and 5.1c(5)).

e. Ownership. Estate of A. Reiner, Martin Goodman, Executor, 1315 Walnut Street, Suite 1207, Philadelphia, PA 19107.

f. Purpose of Dam. Recreation.

g. Design and Construction History. No design or construction data were available from the Executor of the Estate of A. Reiner, nor was any information available in the files of the Department of Environmental Resources, Commonwealth of Pennsylvania (PennDER), except for various inspection reports. The dam was constructed prior to 1914.

The Pennsylvania Water Supply Commission (PWSC) compiled information on Lake Ellyn Dam in 1914 in connection with a survey of dams. The data sheet indicated Lake Ellyn Dam, then called Butler Pond, to be an earth dam, 100 feet long and 8 feet high, with a 10-foot crest width.

A 1917 report by the PWSC described the dam as being an earthfill with upstream and downstream faces protected by dry stone walls. At this time the dam was reported to be 300 feet long, 6 feet high, and 25 feet wide with 6-foot thick masonry walls on the upstream and downstream sides. Between the downstream stone wall and the earthfill, 1 inch wooden plank sheeting had been driven and projected 3 to 4 feet above the crest. The dam was reported to be in poor condition in 1914, with numerous failures of the upstream wall, settlement and erosion of the earthfill, extensive seepage through the dam, and evidence of having been overtopped.

In 1930, the Pennsylvania Water and Power Resources Board prepared an inspection report and judged the dam to be in poor condition. The report noted that the downstream wall was

uneven and about 1 foot low, that seepage was evident at the downstream toe, that framework for a footbridge across the spillway caused an obstruction, and that a new plank cutoff was placed across the dam.

The Pennsylvania Department of Forests and Waters inspected the dam in 1965 and reported the dam was in overall poor condition. Based on data contained in the 1965 report and a comparison of photographs taken in 1930 and 1965, it is believed that the downstream masonry wall was rebuilt and the dam raised about 3 feet between 1930 and 1965. Further, a comparison of the 1965 photographs with present conditions shows that the spillway was rebuilt sometime after 1965.

h. Normal Operational Procedure. The pool is maintained at the spillway crest level with excess inflow discharging over the spillway. There are no emergency drawdown facilities. Spillway discharge flows downstream in Lakeville Creek through Janoske Dam and Craft Pond to the confluence with Purdy Creek, which flows into Lake Wallenpaupack.

1.3 Pertinent Data (existing conditions).

a. Drainage Area. (square miles) 1.24

b. Discharge at Damsite. (cfs)

Maximum known flood at damsite	Unknown
Outlet works at maximum pool elevation	Unknown
Spillway capacity at maximum pool elevation	78

c. Elevation. (feet above msl)

Top of dam	1435.7
Maximum pool	1435.7
Normal pool (spillway crest)	1434.0
Upstream invert outlet works	N/A
Downstream invert outlet works	N/A
Streambed at toe of dam	1427.0

d. Reservoir Length. (miles)

Normal pool	0.41
Maximum pool	0.42

e. Storage. (acre-feet)

Normal pool	126
Maximum pool	228

f.	Reservoir Surface. (acres)	
	Normal pool	54
	Maximum pool	68
g.	Dam.	
	Type	Composite masonry and earthfill.
	Length (feet)	350
	Height (feet)	9
	Top width (feet)	Varies: 12'± Right of Spillway. 16'± Left of Spillway.
	Side Slopes	
	Upstream	Varies (obscured).
	Downstream	Varies, vertical to 1V on 1H.
	Zoning	Central earthfill with dry stone masonry walls upstream and downstream.
	Cut-off	Unknown.
	Grout curtain	None.
h.	Diversion and Regulating Tunnel.	None.
i.	Spillway.	
	Type	Broad-crested concrete weir.
	Length of Weir (feet)	13
	Crest Elevation	1434.0

i.	Spillway. (Cont'd.)	
	Upstream Channel	Reservoir.
	Downstream Channel	Drop to natural stream channel.
j.	Regulating Outlets.	None.

SECTION 2

ENGINEERING DATA

2.1 Design.

a. Data Available. No design data are available for the original dam or subsequent repairs and modifications. No drawings are available.

b. Design Features. The project is described in Paragraph 1.2a. The various features of the dam are shown on the photographs in Appendix C and on the plates in Appendix E.

c. Design Considerations. There is insufficient data to assess the design.

2.2 Construction.

a. Data Available. No construction data are available.

b. Construction Considerations. There are insufficient data to assess the construction.

2.3 Operation. There are no formal records of operation. A record of operation does exist in the form of inspection reports prepared by the Commonwealth between 1914 and 1965. The previous inspections are discussed in Paragraph 1.2g and in Section 5. A summary of these reports is also included in Appendix A.

2.4 Evaluation.

a. Availability. Engineering data were provided by the Bureau of Dams and Waterway Management, Department of Environmental Resources, Commonwealth of Pennsylvania (PennDER). The Owner was not available for information during the visual inspection.

b. Adequacy. The type and amount of available design data and other engineering data are very limited, and the assessment must be based on the combination of available data, visual inspection, performance history, hydrologic assumptions and hydraulic assumptions.

c. Validity. There is no reason to question the validity of available data.

SECTION 3

VISUAL INSPECTION

3.1 Findings.

a. General. The overall appearance of the dam is poor. Some deficiencies were observed as noted below. A sketch of the dam with the locations of the deficiencies is presented on Exhibit B-1 in Appendix B. Survey information acquired for this Report is presented in Appendices B and E. Datum for the survey was taken at the spillway crest, elevation 1434.0. On the day of the inspection the pool was at elevation 1433.4.

b. Embankment. The embankment is in poor condition. The upstream slope has eroded and sloughed the entire length of the dam, at the waterline. The top of the dam is irregular and varies in elevation from 1435.7 to 1437.1. The results of the survey performed for this inspection are shown on Plate E-2. Two depressions were observed on the top of the dam adjacent to the spillway. The largest is to the right of the spillway and is 15 feet x 6 feet x 3.5 feet deep. The second depression is located left of the spillway and is 2.5 feet in diameter x 2 feet deep. An area about 10 feet x 10 feet to the left of the spillway is about 1 foot low. The riprap (masonry) has failed and sloughed on the upstream slope adjacent to the left spillway wall. Considerable seepage, estimated to be about 70 gallons per minute, was observed at the downstream toe beneath and adjacent to the spillway. Numerous birch trees are growing out of the masonry wall on the downstream side of the dam. The masonry wall on the downstream face of the dam has collapsed at several locations. The most critical area is located to the right of the spillway.

c. Appurtenant Structures. Physically the spillway is in fair condition (Photographs D, E and F). The left concrete wingwall on the upstream end of the spillway is spalled at the base. Some minor cracking of the left wall is evident. The spalling and cracking of the spillway walls is of no concern at the present time. The foundation for the spillway slab is uncertain but the spillway appears to have been constructed directly on the earthfill and masonry sections of the dam. The spillway discharges in a straight drop to the natural stream channel. Rock, logs, and debris cover the channel just downstream from the dam.

d. Reservoir Area. The reservoir slopes are very moderate and partially wooded, with some open fields. The watershed is about one-half farmland and one-half woodland, with very moderate slopes.

e. Downstream Conditions. Immediately downstream from the dam, Lakeville Creek passes through open pastureland in a broad floodplain. The channel slope is mild for the first 0.4 mile downstream where the slope increases and the stream valley slopes become more restrictive. Janoske Dam, which is about 15 feet high and impounds 50 acre-feet, is located about 1.3 miles downstream from Lake Ellyn. Lakeville Creek flows into Craft Pond about 2.3 miles down-stream. Two seasonal dwellings are located just downstream from Craft Pond and would experience flooding in the event of a failure of Lake Ellyn Dam. The first damage center is Lakeville, approximately 2.9 miles downstream, where several houses would experience flooding to varying degrees in the case of a failure of Lake Ellyn Dam. Lake Wallenpaupack is 3.8 miles downstream from Lake Ellyn Dam.

A failure of Lake Ellyn Dam would probably cause a failure of Janoske Dam and Craft Pond Dam.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedure. The reservoir is maintained at the spillway crest level with excess discharge flowing downstream. There are no outlet works facilities at the dam.

4.2 Maintenance of Dam. There are no formal regular inspections or maintenance procedures for Lake Ellyn Dam.

4.3 Maintenance of Operating Facilities. There are no operating facilities to maintain.

4.4 Warning Systems in Effect. There is no emergency operation and warning system.

4.5 Evaluation of Operational Adequacy. The maintenance of the upstream and downstream slopes, the top of dam, and the spillway need to be improved. Regular formal inspections are necessary to detect potentially hazardous conditions at the dam. A detailed emergency operation and warning system is necessary to reduce risk of dam failure should adverse conditions develop and to prevent loss of life should the dam fail.

SECTION 5

HYDROLOGY AND HYDRAULICS

5.1 Evaluation of Features.

a. Design Data. No hydrologic or hydraulic design information is available for Lake Ellyn Dam. A report by the Commonwealth, dated 20 July 1917, indicated that the spillway had a capacity of 312 cfs. The spillway has, however, been modified since that time.

b. Experience Data. No reservoir stage, rainfall, or runoff records are available.

c. Visual Observations.

(1) General. The visual inspection of Lake Ellyn Dam, which is described in Section 3, resulted in a number of observations relevant to hydrology and hydraulics.

(2) Embankment. The low areas along the top of the embankment reduce the effective spillway capacity. For the purposes of this report, the elevation of the top of dam is 1435.7 feet.

(3) Appurtenant Structures. The spillway exit channel could be eroded during prolonged discharges from the spillway. No other deficiencies relevant to hydraulics were observed at the spillway or discharge channel.

(4) Reservoir Area. The area surrounding the reservoir is very moderately sloping. The watershed consists primarily of open fields and woods. Two small ponds are located in the watershed, but are not considered to have a significant effect on the hydrology of Lake Ellyn Dam.

(5) Downstream Conditions. No conditions were observed downstream from the dam that would reduce the spillway discharge capacity. Janoske Dam and Craft Pond Dam are located 1.3 and 2.3 miles, respectively, downstream from Lake Ellyn Dam. Lakeville is located about one-half mile downstream from Craft Pond Dam. Conditions are such that an overtopping failure of Lake Ellyn Dam could cause failure of Janoske Dam and Craft Pond Dam and subsequent flooding of several residences in Lakeville.

d. Overtopping Potential.

(1) Spillway Design Flood. According to the criteria established by the Office of the Chief of Engineers (OCE), the Spillway Design Flood (SDF) for the size (small) and hazard potential (high) of Lake Ellyn Dam is between one-half

of the Probable Maximum Flood (PMF) and the PMF. Since the dam is at the low end of the small size category, the 1/2 PMF was selected as the SDF. The watershed and reservoir were modelled with the U.S. Army Corps of Engineers' HEC-1DB computer program. A description of this program is included in Appendix D. The assessment of hydrology and hydraulics is based on existing conditions, and the effects of future development are not considered.

(2) Summary of Results. Pertinent results are tabulated at the end of Appendix D. The analysis reveals that Lake Ellyn Dam can pass only 10 percent of the PMF before overtopping of the dam occurs.

(3) Spillway Adequacy. The criteria used to evaluate the spillway adequacy are described in Appendix D. Since the dam could not pass the 1/2 PMF and was considered to fail during storms as small as 20 percent of the PMF, a breach analysis was performed to ascertain the impact of failure on the downstream area. The conditions contributing to failure, as well as its failure mode, are also included in Appendix D. It was found that failure of the dam during the 1/2 PMF would cause water levels at the damage center in Lakeville to rise 3.3 feet above the levels that would exist if the dam were not to fail. There is an increased hazard for loss of life. Therefore, the spillway capacity is rated as seriously inadequate.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Inspection.

(1) General. The visual inspection of Lake Ellyn Dam, which is described in Section 3, resulted in a number of observations relevant to structural stability. These observations are evaluated herein for the various features.

(2) Embankment. The overall appearance of the embankment is poor. The erosion and sloughing of the upstream slope at the waterline is undesirable. The sinkholes on the top of the dam adjacent to the spillway, the failure and sloughing of the dry stone masonry wall to the right of the spillway, the settlement to the left of the spillway, and the considerable seepage at the toe of the wall near the spillway are all cause for concern for the stability of the dam. It is unknown whether there is active movement of the walls or embankment earthfill at the present time. While all seepage at the time of the inspection was clear, the settlement, sinkholes, and wall failures may be the consequence of seepage through the dam at that location. The trees growing out of the dry stone masonry promote deterioration of the masonry and create potential piping (internal erosion) paths.

(3) Appurtenant Structures. The spillway, being constructed on the embankment, is dependent upon the stability of the embankment and dry stone masonry walls. The failure of the riprap (stone masonry) adjacent to the left spillway headwall and the erosion of the upstream slope at the waterline could result in failure of the spillway walls if conditions continue to deteriorate.

b. Design and Construction Data. No stability analyses are available for Lake Ellyn Dam. There are no definitive data concerning the composition of the dam. There are no data concerning the foundation conditions. Based on visual observations and data in the files, it can be assumed that Lake Ellyn Dam consists of upstream and downstream dry stone masonry walls, with a central earthfill section. Wood planking was driven behind the downstream wall, perhaps as a cutoff. Corrugated metal sheeting is evident along the back face of the downstream wall at several locations. Records indicate that the walls were 6 feet thick at one time, but nothing certain is known regarding the lines or dimensions of the dry stone masonry. The lack of information concerning the foundation, the dry stone masonry walls, and the earthfill section could conceal potentially hazardous internal conditions. The structural stability can only be assessed by consideration of its operating history.

c. Operating Records. There are no formal records of operation. Previous inspection reports provide the only insight into the operating history of the dam.

d. Post-construction Changes. Post-construction changes are described in Paragraph 1.2g. The changes have been assessed with the dam.

e. Seismic Stability. Lake Ellyn Dam is located in Seismic Zone 1. Earthquake loadings are not considered to be significant for small dams located in Seismic Zone 1 when there are no readily apparent stability problems at the dam. However, because of deficiencies at the dam there are some concerns for the stability of the dam under normal operating conditions. It, therefore, cannot be assumed that Lake Ellyn Dam would be stable under earthquake conditions.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND

PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety.

(1) Based on available records, visual inspection, calculations, and past operational performance, Lake Ellyn Dam is judged to be in poor condition. Based on the size and hazard classification of the dam the recommended SDF at the dam varies between the 1/2 PMF and the PMF. Based on the criteria, the selected SDF is the 1/2 PMF. Based on existing conditions, the spillway will pass about 10 percent of the PMF before overtopping of the dam occurs. It is judged that the dam could not withstand the depth and duration of overtopping that would occur for the 1/2 PMF. Failure of the dam would cause an increased hazard for loss of life downstream. The spillway capacity is rated as seriously inadequate. According to criteria established for these studies, the dam is judged to be unsafe, nonemergency, because the spillway capacity is seriously inadequate.

(2) The masonry walls and earthfill section of the embankment are judged to be in poor condition, particularly beneath and adjacent to both sides of the spillway where several signs of distress were observed. Although the records indicate that no serious structural failures have occurred in the past, they do indicate that the dam has been in poor condition since 1917. Information concerning the design and construction is lacking. There is no assurance that potentially hazardous conditions do not exist.

(3) There are no outlet works facilities at the dam.

(4) Maintenance at the dam needs to be improved.

(5) A summary of the features and observed deficiencies is listed below:

Feature	Observed Deficiency
Embankment:	Erosion of upstream slope at water line; depressions on top of dam, left and right of spillway; settlement on top of dam left of spillway; riprap failure on upstream

Feature	Observed Deficiency
Embankment (Cont'd.)	slope left of spillway; seepage under spillway and dam; birch trees growing out of masonry wall; masonry wall on dowstream face collapsed at several places.
Spillway:	Concrete wingwall spalled; minor cracking of left wall; logs and debris at exit.

b. Adequacy of Information. The information available is such that an assessment of the condition of the dam can be inferred from the combination of visual inspection, past performance, and computations performed prior to and as part of this study.

c. Urgency. The recommendations in Paragraph 7.2 should be implemented immediately.

d. Necessity for Further Investigations. In order to accomplish some of the remedial measures outlined in Paragraph 7.2, further investigations by the Owner will be required.

7.2 Recommendations and Remedial Measures.

a. The following studies and remedial measures are recommended to be undertaken by the Owner, in approximate order of priority, immediately:

(1) Perform additional studies to more accurately ascertain the spillway capacity required for Lake Ellyn Dam as well as the nature and extent of measures required to provide adequate spillway capacity. Take appropriate action as required.

(2) Perform investigations as required to determine the lines, grades, and composition of the dam. After such a determination has been made, studies should be performed to assess the dam for any potentially hazardous conditions that might exist, including stability and seepage. Take appropriate action as required. Until action is taken, the depressions and low areas on the top of the dam should be filled and the embankment monitored. The collapsed sections of the downstream wall should also be monitored.

(3) Develop a suitable means of drawing down the reservoir in case of an emergency. Any pipe that is placed through the embankment should be provided with an upstream closure facility.

(4) Remove the trees from the downstream walls.

(5) Repair the eroded areas on the upstream slope and provide suitable erosion protection.

All investigations, studies, designs, and inspection of construction should be performed by a professional engineer experienced in the design and construction of dams. Tree removal should also be under the guidance of a professional engineer.

b. In addition, the Owner should institute the following operational and maintenance procedures:

(1) Develop a detailed emergency operation and warning system for Lake Ellyn Dam. When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system.

(2) During periods of unusually heavy rains, provide round-the-clock surveillance of the dam.

(3) Initiate an inspection program at the dam such that the dam is inspected on a regular basis. As presently required by the Commonwealth, the inspection program should include a formal annual inspection by a professional engineer experienced in the design and construction of dams. Utilize the inspection results to determine if remedial measures are necessary.

(4) Institute a maintenance program and develop a formal maintenance manual so that all features of the dam are properly maintained.

APPENDIX A

CHECKLIST - ENGINEERING DATA

CHECKLIST

ENGINEERING DATA

DESIGN, CONSTRUCTION, AND OPERATION
PHASE I

NAME OF DAM: Lake Ellyn

NDI ID NO.: PA-00136 DER ID NO.: 51-32

Sheet 1 of 4

ITEM	REMARKS
AS-BUILT DRAWINGS	None
REGIONAL VICINITY MAP	See Plate E-1.
CONSTRUCTION HISTORY	Constructed prior to 1914; no other information available.
TYPICAL SECTIONS OF DAM	See Plate E-2.
OUTLETS: Plan Details Constraints Discharge Ratings	No details available.

ENGINEERING DATA

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	None
DESIGN REPORTS	Brief description of features in 1917 report prepared by Pennsylvania Water Supply Commission.
GEOLOGY REPORTS	None
DESIGN COMPUTATIONS: Hydrology and Hydraulics Dam Stability Seepage Studies	None
MATERIALS INVESTIGATIONS: Boring Records Laboratory Field	None
POSTCONSTRUCTION SURVEYS OF DAM	None

ENGINEERING DATA

ITEM	REMARKS
BORROW SOURCES	Unknown
MONITORING SYSTEMS	None
MODIFICATIONS	Spillway reconstructed some time after 1965; no information or plans are available.
HIGH POOL RECORDS	None
POSTCONSTRUCTION ENGINEERING STUDIES AND REPORTS	None
PRIOR ACCIDENTS OR FAILURE OF DAM: Description Reports	None reported.

ENGINEERING DATA

ITEM	REMARKS
MAINTENANCE AND OPERATION RECORDS	None
SPILLWAY: Plan Sections Details	Plan shown on Exhibit B-1.
OPERATING EQUIPMENT: Plans Details	None
PREVIOUS INSPECTIONS Dates Deficiencies	1965 - leakage at toe; spillway needs repairs; general appearance - poor.
	1930 - Downstream wall is uneven and about one foot low; leakage along entire toe; spillway spanned by small footbridge and wooden framework.
	1917 - Dilapidated condition; extensive leakage through dam.

APPENDIX B

CHECKLIST - VISUAL INSPECTION

CHECKLIST

VISUAL INSPECTION

PHASE I

Name of Dam: Lake Ellyn County: Wayne State: Pennsylvania

NDI ID No.: PA-00138 DER ID No.: 64-32

Type of Dam: Earth and Masonry Hazard Category: High

Date(s) Inspection: 28 October 1980 Weather: Overcast, windy Temperature: 50°F

Pool Elevation at Time of Inspection: 1433.4 ft. msl/Tailwater at Time of Inspection: 1427.0 ft. msl

Note: Elevations estimated from USGS quadrangle - Lakeville, PA

Inspection Personnel:

W.B. Bingham (GFCC)

R.E. Holderbaum (GFCC)

D.P. Ebersole (GFCC)

R.E. Holderbaum Recorder

EMBANKMENT

Sheet 1 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	N/A	Downstream side of dam is constructed of dry stone masonry.
SLOUGHING OR EROSION: Embankment Slopes Abutment Slopes	Upstream slope badly eroded and sloughed along entire length. Abutment slopes - good	
CREST ALIGNMENT: Vertical Horizontal	Horizontal - good Vertical - poor - sinkhole on right side of spillway 15' x 6' x 3½' dp; sink to left of spillway 2½' ϕ x 2' dp;	Low area to the left of the spillways 10' x 10' x 12" low; sinkhole and low areas possibly caused by seepage at spillways crest covered w/ grass.
RIPRAP FAILURES	Riprap on upstream slope adjacent to left spillway wall has failed and sloughed.	

EMBANKMENT

Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT WITH: Abutment Spillway Other Features	Abutment - good spillway - see previous page (CREST ALIGNMENT)	
ANY NOTICEABLE SEEPAGE	Seepage under spillway and at toe of dam 30 feet right of spillway estimated 70 gpm.	seepage may be responsible for embankment settlement and sinkhole.
STAFF GAGE AND RECORDER	None	
DRAINS	None observed	
TREES	Numerous birch trees are growing out of the masonry on the downstream face of the dam.	

CONCRETE/MASONRY DAMS

Sheet 1 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	See EMBANKMENT (sheet 2 of 2)	
JUNCTION OF STRUCTURE WITH: Abutment Embankment Other Features	Masonry wall on downstream face of dam has collapsed away from earth embankment at several places	The wall is noticeably worse on the right side of the spillway.
DRAINS	None observed	
WATER PASSAGES	N/A	
FOUNDATION	N/A	

CONCRETE/MASONRY DAMS

Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SURFACES: Surface Cracks Spalling	N/A	
STRUCTURAL CRACKING	N/A	
ALIGNMENT: Vertical Horizontal	Poor - top section of masonry wall has collapsed at several locations	
MONOLITH JOINTS	N/A	
CONSTRUCTION JOINTS	N/A	
STAFF GAGE OR RECORDER	None	

UNGATED SPILLWAY

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Concrete wingwall on lake end of spillway is spalled at base (2" deep); inside of left training wall at base	has been patched; some minor cracking of left wall; overall - fair condition.
APPROACH CHANNEL	Lake - unobstructed.	
DISCHARGE CHANNEL	Marshy stream channel at toe of dam; some debris and logs at spillway exit.	Logs and debris will not interfere with spillway discharges.
BRIDGE AND PIERS	N/A	

INSTRUMENTATION

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER		

RESERVOIR AND WATERSHED

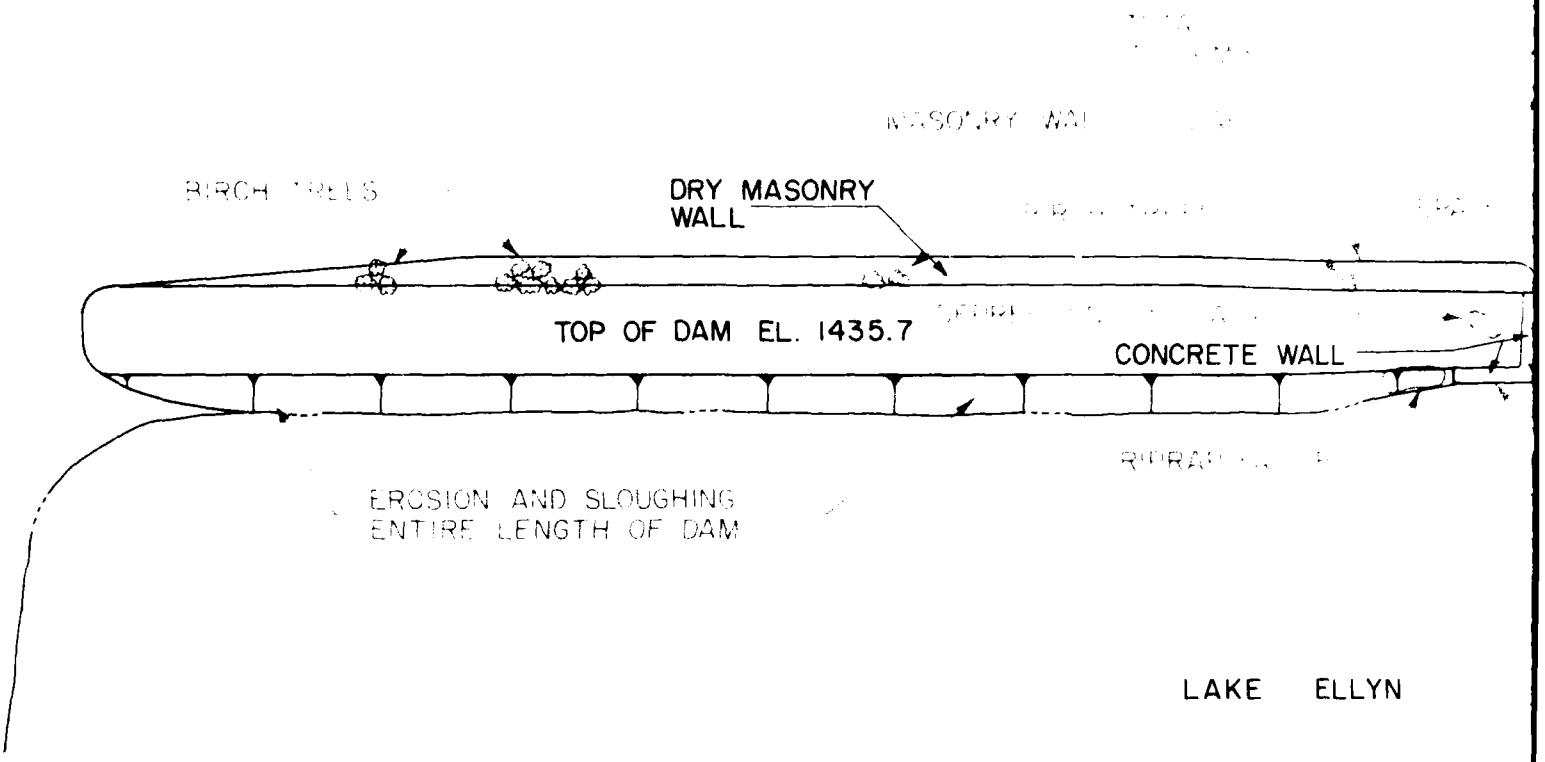
Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Very moderately sloping; partially wooded, some open fields.	No sign of instability observed.
SEDIMENTATION	Unknown	
WATERSHED DESCRIPTION	Approximately one-half farmland and one-half woodland	

DOWNSTREAM CHANNEL

Sheet 1 of 1

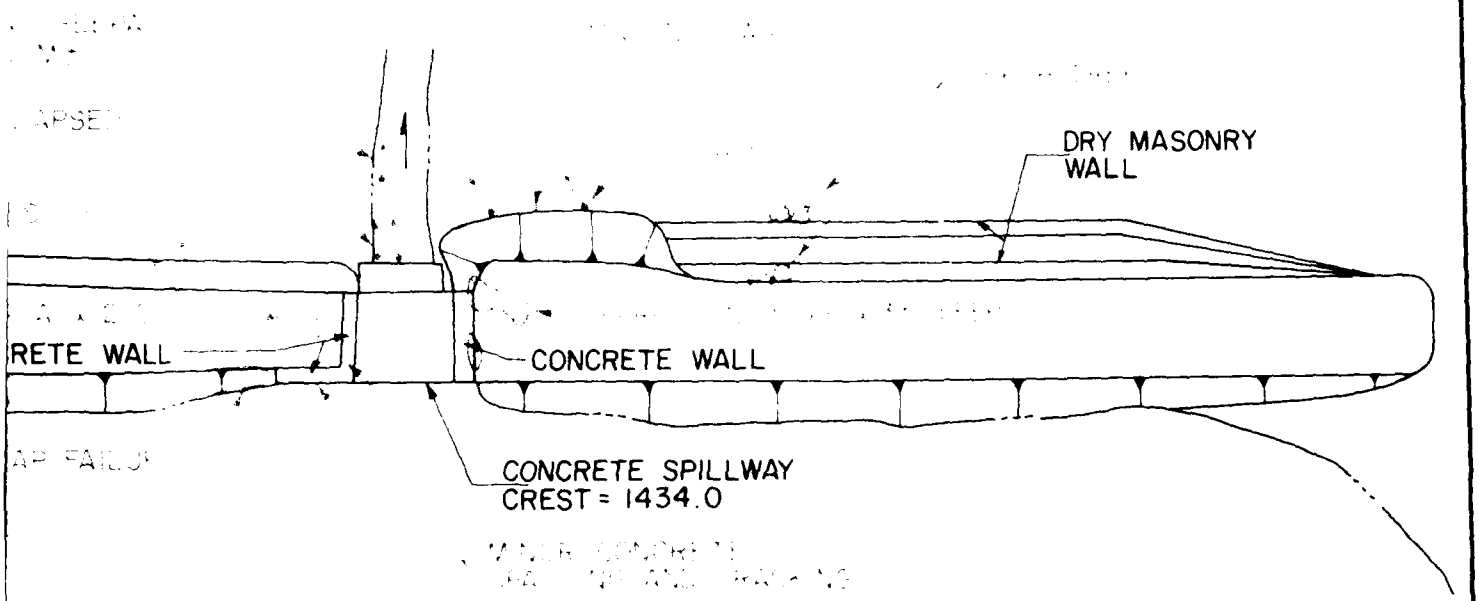
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION: Obstructions Debris Other	Two small dams 1.3 miles and 2.3 miles downstream	The lakes impounded by these dams are significantly smaller than Lake Ellen.
SLOPES	Varies, slope of channel just below dam is mild but increases as it progresses downstream	
APPROXIMATE NUMBER OF HOMES AND POPULATION	Two seasonal dwellings are located just downstream of Craft Ford; several houses in Lakeville would experience flooding in the	case of a failure of Lake Ellyn Dam. Population about 20.



DATE OF INSPECTION: 28 OCTOBER 1980
POOL ELEVATION: 1433.4 FEET

APPROXIMATE SCALE: 1 IN. = 25 FT.

25 0 25 50



LAKE ELLYN

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAKE ELLYN DAM

ESTATE OF A. REINER

RESULTS OF
VISUAL INSPECTION

JANUARY 1981

EXHIBIT B-1

SCALE: 1 IN. = 25 FT.

25 50

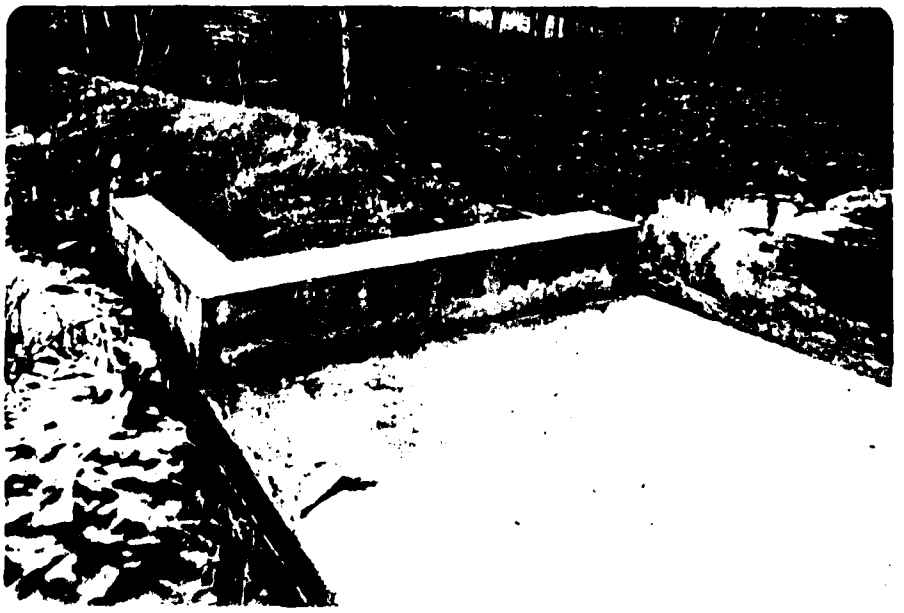
APPENDIX C

PHOTOGRAPHS

A. Downstream Side of Dam

B. Downstream Side of Dam - To Left of Spillway

C. Spillway Overflow



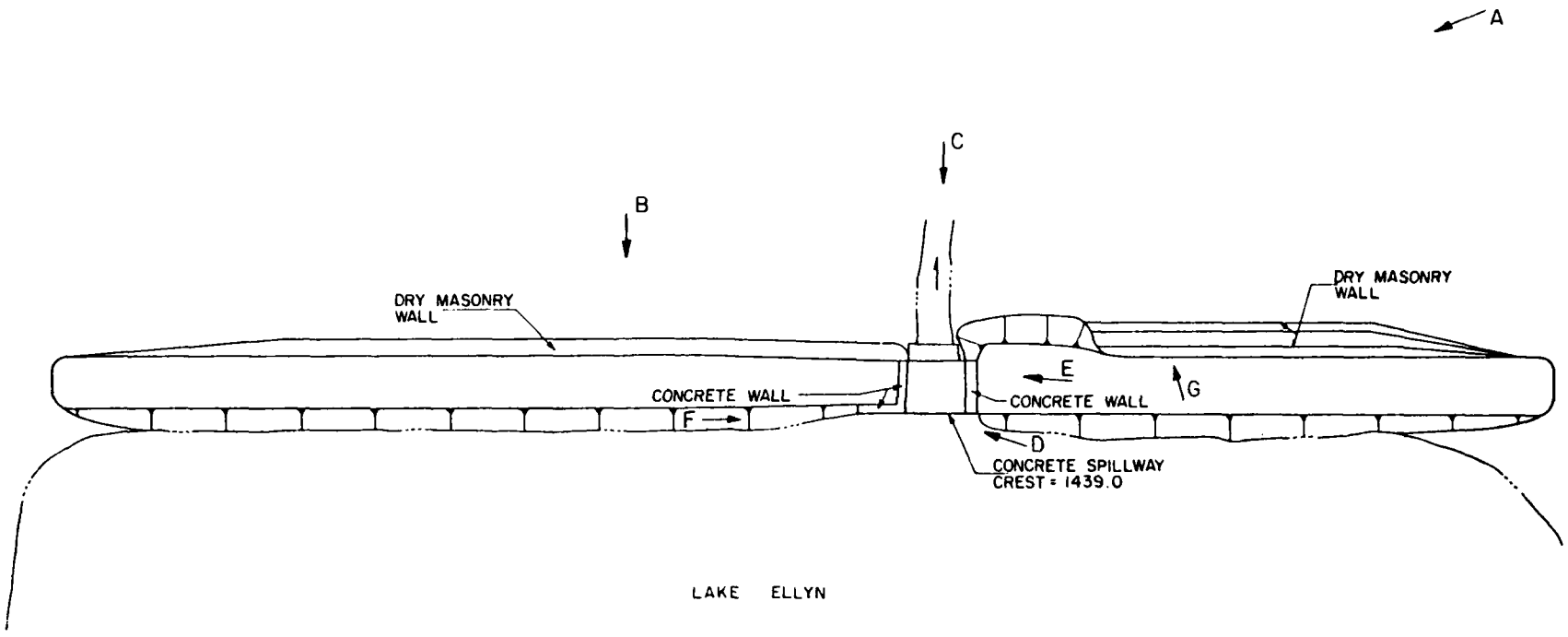
D. Spillway

1. Depression Adjacent to Spillway

2. Upstream Slope and Spillway Entrance

G. Stream Valley Immediately Downstream from Dam

H. Craft Pond Dam - Two Miles Downstream



NOT TO SCALE

← LOCATION AND ORIENTATION OF CAMERA

A PHOTOGRAPH IDENTIFICATION LETTER

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAKE ELLYN DAM

ESTATE OF A. REINER

GUIDE TO LOCATION OF PHOTOGRAPHS

JANUARY 1981

EXHIBIT C-1

APPENDIX D

HYDROLOGY AND HYDRAULICS

APPENDIX D

HYDROLOGY AND HYDRAULICS

Spillway Capacity Rating:

In the recommended Guidelines for Safety Inspection of Dams, the Department of the Army, Office of the Chief of Engineers (OCE), established criteria for rating the capacity of spillways. The recommended Spillway Design Flood (SDF) for the size (small, intermediate, or large) and hazard potential (low, significant, or high) classification of a dam is selected in accordance with the criteria. The SDF for those dams in the high hazard category varies between one-half of the Probable Maximum Flood (PMF) and the PMF. If the dam and spillway are not capable of passing the SDF without overtopping failure, the spillway capacity is rated as inadequate. If the dam and spillway are capable of passing one-half of the PMF without overtopping failure, or if the dam is not in the high hazard category, the spillway capacity is not rated as seriously inadequate. A spillway capacity is rated as seriously inadequate if all of the following conditions exist:

(a) There is a high hazard to loss of life from large flows downstream of the dam.

(b) Dam failure resulting from overtopping would significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure.

(c) The dam and spillway are not capable of passing one-half of the PMF without overtopping failure.

Description of Model:

If the Owner has not developed a PMF for the dam, the watershed is modeled with the HEC-1DB computer program, which was developed by the U.S. Army Corps of Engineers. The HEC-1DB computer program calculates a PMF runoff hydrograph (and percentages thereof) and routes the flows through both reservoirs and stream sections. In addition, it has the capability to simulate an overtopping dam failure. By modifying the rainfall criteria, it is also possible to model the 100-year flood with the program.

APPENDIX D

DELAWARE River Basin
Name of Stream: LAKEVILLE CREEK
Name of Dam: LAKE ELLYN DAM
NDI ID No.: PA-00138
DER ID No.: 64-32
Latitude: N 41° 26.5' Longitude: W 75° 19.0'
Top of Dam Elevation: 1435.7
Streambed Elevation: 1427.0 Height of Dam: 9 ft
Reservoir Storage at Top of Dam Elevation: 228 acre-ft
Size Category: SMALL
Hazard Category: HIGH (see Section 5)
Spillway Design Flood: 1/2 PMF

UPSTREAM DAMS

Name	Distance from Dam (miles)	Height (ft)	Storage at top of Dam Elevation (acre-ft)	Remarks
(TWO SMALL PONDS (NEGLECTED IN HYDROLOGIC ANALYSIS)				

DOWNSTREAM DAMS

JANOSKE DAM*	1.0	15±	<50	DER ID. 64-114
CRAFT POND	2.0	14	105	DER ID. 64-27

* NEGLECTED IN HYDROLOGIC ANALYSIS

DELAWARE River Basin

Name of Stream: LAKEVILLE CREEK

Name of Dam: LAKE ELLYN DAM

DETERMINATION OF PMF RAINFALL & UNIT HYDROGRAPH

UNIT HYDROGRAPH DATA:

Sub-area	Drainage Area (square miles)	Cp (1)	Ct (2)	L* miles (3)	L_{ca}* miles (4)	L' miles (5)	Tp hours (6)	Map Area (7)	Plate (8)
A-1	1.34	0.45	1.23	1.17	0.44	N/A	1.01	1	A
Total									

(See Sketch on Sheet D-4)

(1) & (2): Snyder Unit Hydrograph coefficients supplied by Baltimore District, Corps of Engineers on maps and plates referenced in (7) & (8)

The following are measured from the outlet of the subarea:

(3): Length of main watercourse extended to divide

(4): Length of main watercourse to the centroid

The following is measured from the upstream end of the reservoir at normal pool:

(5): Length of main watercourse extended to divide

(6): $Tp=C_t \times (L \times L_{ca})^{0.3}$, except where the centroid of the subarea is located in the reservoir. Then $Tp=C_t \times (L')^{0.6}$

Initial flow is assumed at 1.5 cfs/sq. mile

Computer Data: QRCSN = -0.05 (5% of peak flow)
RTIOR = 2.0

RAINFALL DATA:

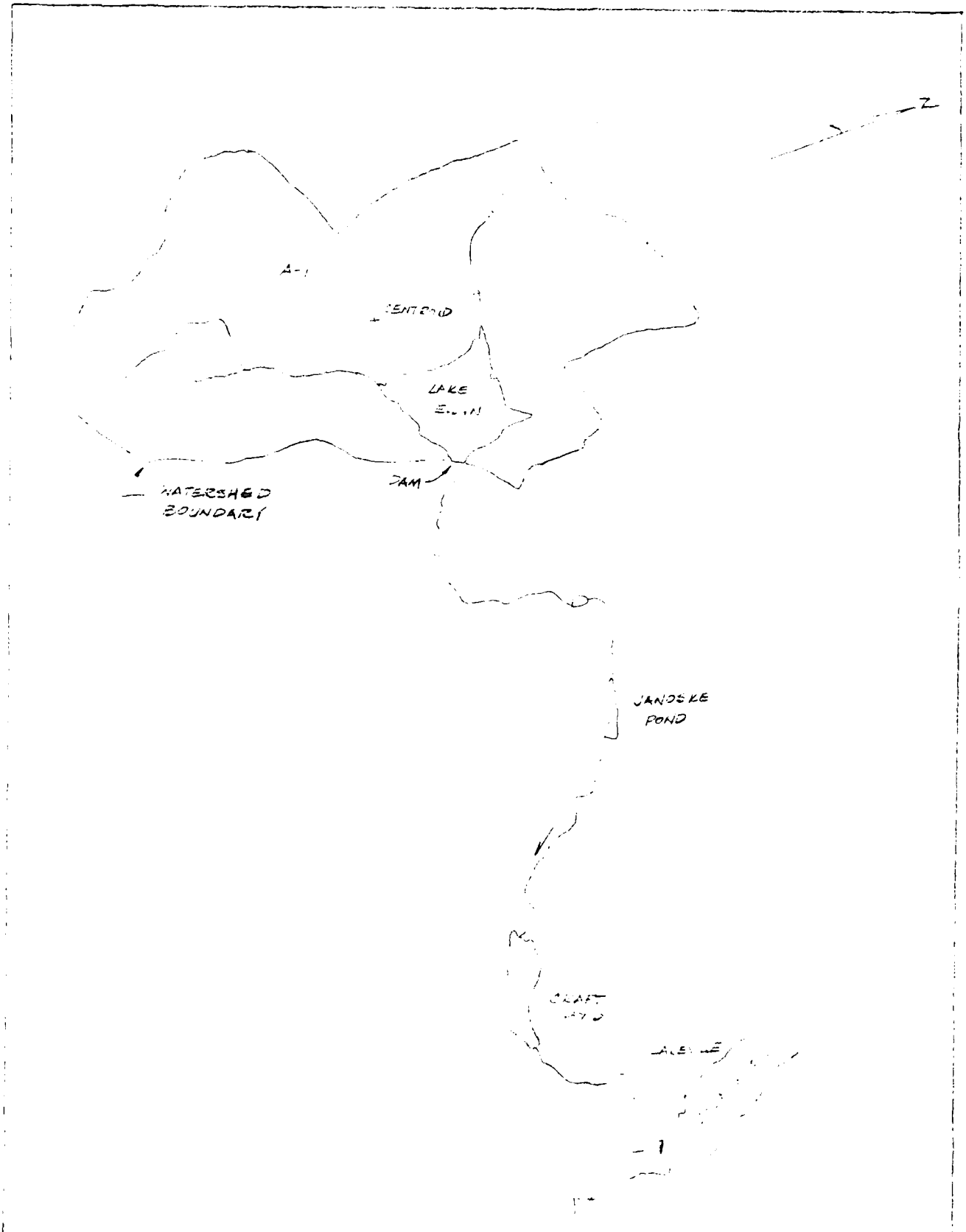
PMF Rainfall Index= 21.5 in., 24 hr., 200 sq. mile

	Hydromet. 40 (Susquehanna Basin)	Hydromet. 33 (Other Basins)
Zone:	N/A	1
Geographic Adjustment Factor:		1.0
Revised Index Rainfall:		21.5

RAINFALL DISTRIBUTION (percent)

Time	Percent
6 hours	111
12 hours	123
24 hours	133
48 hours	142
72 hours	
96 hours	

* AVERAGE OF TWO MAIN WATERCOURSES



LAKE ELVA DAM
SKETCH OF SYSTEM

Data for Dam at Outlet of Subarea A-1

Name of Dam: LAKE ELLYN DAM

SPILLWAY DATA:	Existing Conditions	Design Conditions
		(N/A)
Top of Dam Elevation	1435.7	
Spillway Crest Elevation	1434.0	
Spillway Head Available (ft)	1.7	
Type Spillway	CONCRETE, BROAD-CRESTED WEIR	
"C" Value - Spillway	2.7	
Crest Length - Spillway (ft)	13.1	
Spillway Peak Discharge (cfs)	78	
Auxiliary Spillway Crest Elev.	NOT APPLICABLE	
Auxiliary Spill. Head Avail. (ft)		
Type Auxiliary Spillway		
"C" Value - Auxiliary Spill. (ft)		
Crest Length - Auxil. Spill. (ft)		
Auxiliary Spillway Peak Discharge (cfs)		
Combined Spillway Discharge (cfs)		

Spillway Rating Curve: $Q = CLH^{1.5} = 35.4H^{1.5}$

Elevation	Q Spillway (cfs)	Q Auxiliary Spillway (cfs)	Combined (cfs)

OUTLET WORKS RATING:	Outlet 1	Outlet 2	Outlet 3
		NOT APPLICABLE	
Invert of Outlet			
Invert of Inlet			
Type			
Diameter (ft) = D			
Length (ft) = L			
Area (sq. ft) = A			
N			
K Entrance			
K Exit			
K Friction=$29.1_N{}^2L/R^{4/3}$			
Sum of K			
$(1/K)^{0.5} = C$			
Maximum Head (ft) = HM			
$Q = CA\sqrt{2g(HM)}$(cfs)			
Q Combined (cfs)			

Data for Dam at Outlet of Subarea A-1 (See sketch on Sheet D-4)

Name of Dam: LAKE ELLYN DAM

STORAGE DATA:

Elevation		Area (acres)		Storage million gals	acre-ft		Remarks
	=ELEVO*	0		0	0		
1434.0	=ELEV1	54	=A1	41	126	=S1	NORMAL POOL
1440.0		102					

* ELEVO = ELEV1 - $(3S_1/A_1)$

** Planimetered contour at least 10 feet above top of dam

Reservoir Area at Normal Pool is 7 percent of subarea watershed.

BREACH DATA:

See Appendix B for sections and existing profile of the dam.

Soil Type from Visual Inspection: COMPOSITE

Maximum Permissible Velocity (Plate 28, EM 1110-2-1601) 4.6 fps
(from $Q = CLH^{3/2} = V \cdot A$ and depth = (2/3) x H) & A = L·depth

HMAX = $(4/9\ V^2/C^2)$ = 1.0 ft., C = 3.1 Top of Dam El.= 1435.7

HMAX + Top of Dam El. = 1436.7 FEET = FAILEL
(Above is elevation at which failure would start)

Dam Breach Data:

BRWID = 20 ft (width of bottom of breach)
Z = 0.5 (side slopes of breach)
ELBM = 1427.0 (bottom of breach elevation, minimum of zero storage elevation)
WSEL = 1434.0 (normal pool elevation)
T FAIL= 60 mins = 1.0 hrs (time for breach to develop)

Data for Dam at Outlet of Subarea_____

Name of Dam: CRAFT POND DAM

SPILLWAY DATA:	Existing Conditions	Design Conditions (N/A)
Top of Dam Elevation	1329.2	
Spillway Crest Elevation	1325.0	
Spillway Head Available (ft)	4.2	
Type Spillway	CONCRETE OVERFLOW	
"C" Value - Spillway	3.1	
Crest Length - Spillway (ft)	40.2	
Spillway Peak Discharge (cfs)	1073	
Auxiliary Spillway Crest Elev.		
Auxiliary Spill. Head Avail. (ft)		
Type Auxiliary Spillway		
"C" Value - Auxiliary Spill. (ft)	N/A	
Crest Length - Auxil. Spill. (ft)		
Auxiliary Spillway Peak Discharge (cfs)		
Combi. d Spillway Discharge (cfs)		

Spillway Rating Curve: $Q = CLH^{1.5} = 124.6H^{1.5}$

Elevation	Q Spillway (cfs)	Q Auxiliary Spillway (cfs)	Combined (cfs)

OUTLET WORKS RATING:	Outlet 1 (N/A)	Outlet 2 (N/A)	Outlet 3 (N/A)
Invert of Outlet			
Invert of Inlet			
Type			
Diameter (ft) = D			
Length (ft) = L			
Area (sq. ft) = A			
N			
K Entrance			
K Exit			
K Friction=$29.1_N{}^2L/R^{4/3}$			
Sum of K			
$(1/K)^{0.5} = C$			
Maximum Head (ft) = HM			
$Q = CA\sqrt{2g(HM)}$(cfs)			
Q Combined (cfs)			

Data for Dam at Outlet of Subarea _____ (See sketch on Sheet D-4)

Name of Dam: CRAFT POND DAM

STORAGE DATA:

Elevation		Area (acres)		Storage million gals	acre-ft		Remarks
1315	=ELEVO*	0		0	0		
1325	=ELEV1	13	=A1	14	43	=S1	NORMAL POOL
1340**		28					

* ELEVO = ELEV1 - $(3S_1/A_1)$

** Planimetered contour at least 10 feet above top of dam

Reservoir Area at Normal Pool is N/A percent of subarea watershed.

BREACH DATA:

See Appendix B for sections and existing profile of the dam.

Soil Type from Visual Inspection: SILT & CLAY (GRASS COVERED)

Maximum Permissible Velocity (Plate 28, EM 1110-2-1601) 4.6 fps
(from $Q = CLH^{3/2} = V \cdot A$ and depth = (2/3) x H) & A = L·depth

HMAX = $(4/9\ V^2/C^2)$ = 1.0 ft., C = 3.1 Top of Dam El.= 1329.2

HMAX + Top of Dam El. = 1330.2 FEET = FAILEL
(Above is elevation at which failure would start)

Dam Breach Data:

BRWID = 60 ft (width of bottom of breach)
Z = 0.5 (side slopes of breach)
ELBM = 1315.0 (bottom of breach elevation, minimum of zero storage elevation)
WSEL = 1325.0 (normal pool elevation)
T FAIL= 60 mins = 1.0 hrs (time for breach to develop)

BY _____ DATE _____ SUBJECT _____ SHEET NO _____ OF _____

CHKD BY _____ DATE _____ JOB NO _____

FLOOD ROUTING AND DAM FAILURE ASSUMPTIONS

1. Canoske Dam, located 1.3 miles downstream from Lake Ellyn Dam, was neglected in the analysis. It has very little storage capacity and was, therefore, not considered to have any appreciable effect on the area downstream.

2. Craft Pond Dam was assumed to fail during failure of Lake Ellyn Dam. The analysis reveals that overtopping of Craft Pond Dam would be increased by nearly 1.0 foot during failure versus non-failure of Lake Ellyn Dam.

3. Three stream valley cross-sections were used to route the flood wave from Lake Ellyn to Craft Pond. One stream section was used to continue the routing from Craft Pond to the Damage Center in Lakeville, PA.

BY _____ DATE _____ SUBJECT _____ SHEET NO _____ OF _____

CHKD BY _____ DATE _____ JOB NO _____

SELECTED COMPUTER OUTPUT

```
**********
FLOOD HYDRO[illegible]PH PACKAGE (HEC-1)
DAM SAFETY    SION      JULY 1978
  LAST MODIFICATION  01 APR 80
**********
```

NATIONAL DAM INSPECTION PROGRAM
BALTIMORE DISTRICT CORPS OF ENGINEERS
LAKE ELLYN DAM

```
     1          A1
     2          A2
     3          A3
     4          B     300       0        15        0         0         0         0         0        -4         0
     5          B1      5
     6          J       1        6         1
     7          J1    1.0      0.5       0.3       0.2       0.1      0.05
     8          K       0        1
     9          K1       INFLOW TO LAKE ELLYN                                    1
    10          M       1        1      1.24                 1.24
    11          P              21.5       111       123       133       142                                  1
    12          T
    13          W     1.01     0.45                                              1.0      0.05                0.07
    14          X     -1.5    -0.05       2.0
    15          K       1        1                                               1
    16          K1       ROUTE THROUGH LAKE ELLYN
    17          Y                                            1         0
    18          Y1      1                                                                -1434
    19          $A      0       54       102
    20          $E   1427     1434      1440
    21          $S   1434     13.1       2.7       1.5
    22          $D1435.7
    23          $L      0       35       312       348       364       377
    24          $V1435.7   1436.4    1437.0    1437.5    1438.0    1438.5
    25          K      99
```

D-11

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00	RATIO 2 .50	RATIO 3 .30	RATIO 4 .20	RATIO 5 .10	RATIO 6 .05
HYDROGRAPH AT	1	1.24	1	3481.	1741.	1044.	696.	348.	174.
		(3.21)		(98.58)(	49.29)(	29.58)(	19.72)(	9.86)(	4.93)(
ROUTED TO	1	1.24	1	3195.	1491.	729.	316.	82.	34.
		(3.21)		(90.48)(	42.23)(	20.65)(	8.94)(	2.33)(	.96)(

21-0

SUMMARY OF DAM SAFETY ANALYSIS

Lake Ellyn Dam

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1434.00	1434.00	1435.70
STORAGE	126.	126.	228.
OUTFLOW	0.	0.	78.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1438.58	2.88	450.	3195.	22.50	41.25	0.00
.50	1437.77	2.07	381.	1491.	18.25	41.50	0.00
.30	1437.27	1.57	341.	729.	15.50	42.25	0.00
.20	1436.84	1.14	308.	316.	13.25	43.25	0.00
.10	1435.75	.05	231.	82.	3.00	44.25	0.00
.05	1434.97	0.00	182.	34.	0.00	44.75	0.00

D-13

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  01 APR 80
**********************************
    1                A1                    NATIONAL DAM INSPECTION PROGRAM
    2                A2                BALTIMORE DISTRICT CORPS OF ENGINEERS
    3                A3                          LAKE ELLYN DAM
    4                B     300        0       15        0        0        0        0        0       -4        0
    5                B1      5
    6                J       2        1        1
    7                J1    0.5
    8                K       0        1                                          1
    9                K1          INFLOW TO LAKE ELLYN
   10                M       1        1    1.24                  1.24                                  1
   11                P                21.5      111      123      133      142
   12                T                                                          1.0     0.05             0.07
   13                W    1.01     0.45
   14                X    -1.5    -0.05      2.0
   15                K       1        1                                          1
   16                K1          ROUTE THROUGH LAKE ELLYN
   17                Y                                         1        1
   18                Y1      1                                                 -1434
   19                SA      0       54      102
   20                SE   1427     1434     1440
   21                SS   1434     13.1      2.7      1.5
   22                SD1435.7
   23                SL      0       35      312      348      364      377
   24                SV1435.7   1436.4   1437.0   1437.5   1438.0   1438.5
   25                SB     20      0.5     1427      1.0     1434     1440
   26                SB     20      0.5     1427      1.0     1434   1436.7
   27                K       1        2                                          1
   28                K1          STREAM REACH 1
   29                Y                                         1        1
   30                Y1      1                                                 -1
   31                Y6   0.07     0.04     0.07     1425     1440     2200   0.0041
   32                Y7      0     1460      120     1440      610     1428      610     1425      640     1425
   33                Y7    640     1428     1400     1440     1550     1460
   34                K       1        3                                          1
   35                K1          STREAM REACH 2
   36                Y                                         1        1
   37                Y1      1                                                 -1
   38                Y6   0.09     0.04     0.09     1387     1405     4900   0.0086
   39                Y7      0     1420      150     1400      230     1390      230     1387      250     1387
   40                Y7    250     1390      300     1400      420     1420
   41                K       1        4                                          1
   42                K1          STREAM REACH 3
   43                Y                                         1        1
   44                Y1      1                                                 -1
   45                Y6   0.09     0.04     0.09     1340     1360     3500   0.0157
   46                Y7      0     1390      120     1360      290     1343      290     1340      310     1340
   47                Y7    310     1343      400     1360      480     1380
   48                K       1        5                                          1
   49                K1          ROUTE THROUGH CRAFT POND DAM
   50                Y                                         1        1
```

D-14

```
51          Y1     1                                                  -1325        0
52          $A     0       13      28
53          $E  1315     1325    1340
54          $$  1325     40.2     3.1     1.5
55          $D1329.2      2.5     1.5     100
56          $B    60      0.5    1315     1.0     1325     1340
57          $B    60      0.5    1315     1.0     1325   1330.2
58          K      1        6                                            1
59          K1          STREAM REACH 6
60          Y                                    1        1
61          Y1     1                                                    -1
62          Y6  0.09     0.04    0.09     1271     1285     2400  0.0225
63          Y7     0     1300      80     1280      110     1274     110    1271     130    1271
64          Y7   130     1274     250     1280      410     1300
65          K     99
```

SUMMARY OF DAM SAFETY ANALYSIS

Lake Ellyn Dam

PLAN 1		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	ELEVATION	1434.00	1434.00	1435.70
	STORAGE	126.	126.	228.
	OUTFLOW	0.	0.	78.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	1437.77	2.07	381.	1491.	18.25	41.50	0.00

PLAN 2		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	ELEVATION	1434.00	1434.00	1435.70
	STORAGE	126.	126.	228.
	OUTFLOW	0.	0.	78.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	1437.22	1.52	337.	2750.	4.25	40.75	39.75

PLAN 1 STATION 2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	1476.	1430.3	41.75

PLAN 2 STATION 2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	2503.	1431.3	41.00

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	1464.	1393.4	42.00

PLAN 2 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	2403.	1395.1	41.25

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PLAN 1 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	1658.	1345.5	42.00

PLAN 2 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	2398.	1347.0	41.50

SUMMARY OF DAM SAFETY ANALYSIS

Craft Pond Dam

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1325.00	1325.00	1329.20
STORAGE	43.	43.	105.
OUTFLOW	0.	0.	1073.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	1329.78	.58	115.	1412.	2.50	42.50	0.00

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1325.00	1325.00	1329.20
STORAGE	43.	43.	105.
OUTFLOW	0.	0.	1073.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	1330.69	1.49	131.	4742.	1.06	42.46	41.50

PLAN 1 STATION 6

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	1406.	1275.8	42.75

Damage Center

PLAN 2 STATION 6

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	4027.	1279.1	42.50

BY _____ DATE _____ SUBJECT _____ SHEET NO _____ OF _____

CHKD BY _____ DATE _____ JOB NO _____

LAKE ELLYN DAM

Summary of Pertinent Results

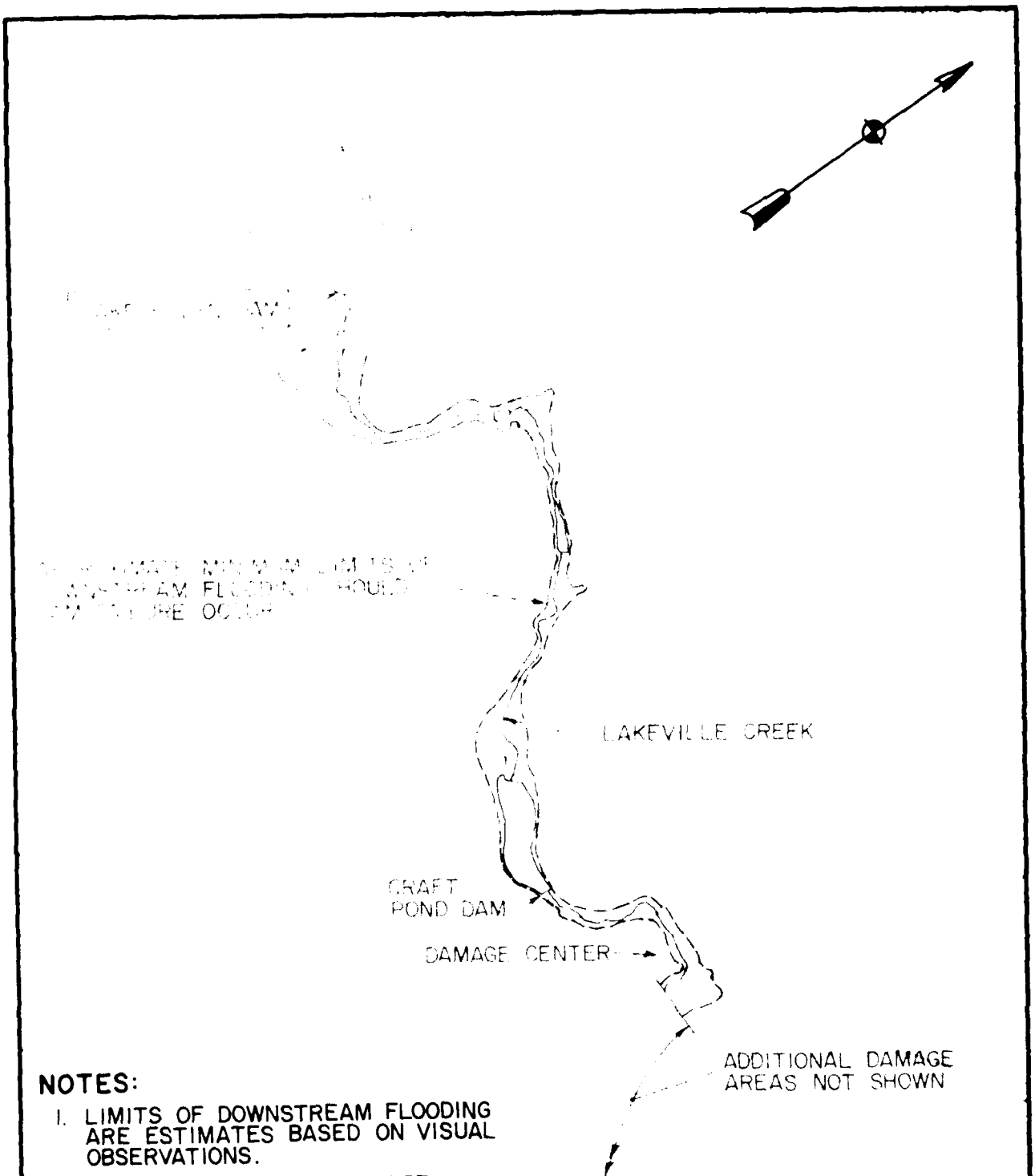
Multi-ratio Analysis:

	PMF	1/2 PMF
Rainfall (inches)	24.42	–
Runoff (inches)	22.20	11.10
Peak Inflow (cfs.)	3481	1741
Peak Outflow (cfs)	3195	1491
Depth of Overtopping (ft)	2.38	2.07
Duration of Overtopping (hrs.)	22.50	18.25

Dam Breach and Routing Analysis: (1/2 PMF)

	No failure	Failure	Difference
Peak outflow (cfs)*	1491	2750	1259
Stream Depth at Damage Center	4.8	8.1	3.3

* at Lake Ellyn Dam



NOTES:

1. LIMITS OF DOWNSTREAM FLOODING ARE ESTIMATES BASED ON VISUAL OBSERVATIONS.
2. CIRCLED NUMBERS INDICATE STATIONS USED IN COMPUTER ANALYSIS.
3. THIS MAP SHOULD NOT BE USED IN CONNECTION WITH THE EMERGENCY OPERATION AND WARNING PLAN

2000 0 2000

SCALE: 1 IN. = 2000 FT.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAKE ELLYN DAM

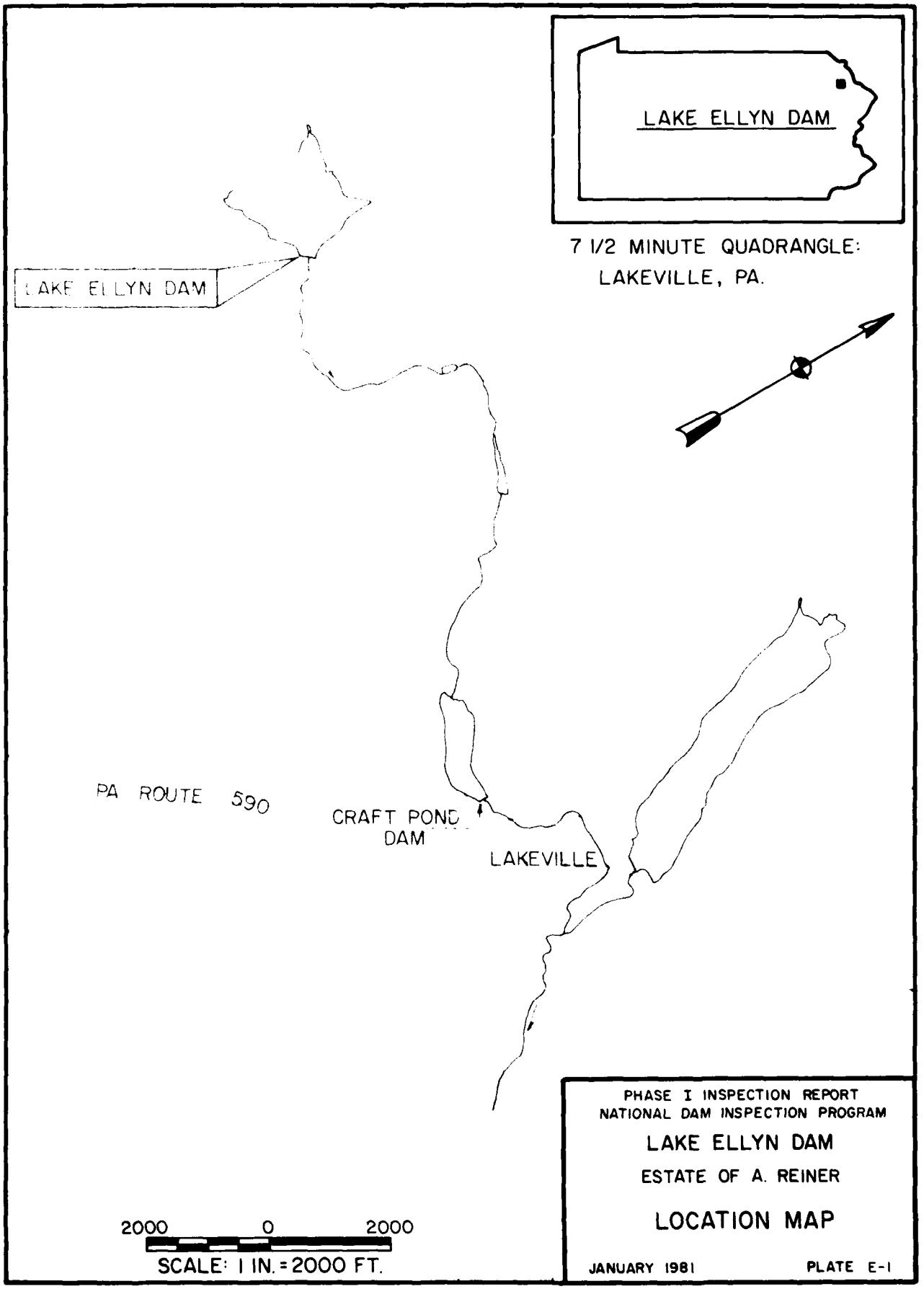
ESTATE OF A. REINER

DOWNSTREAM DEVELOPMENT PLAN

JANUARY 1981 EXHIBIT D-1

APPENDIX E

PLATES



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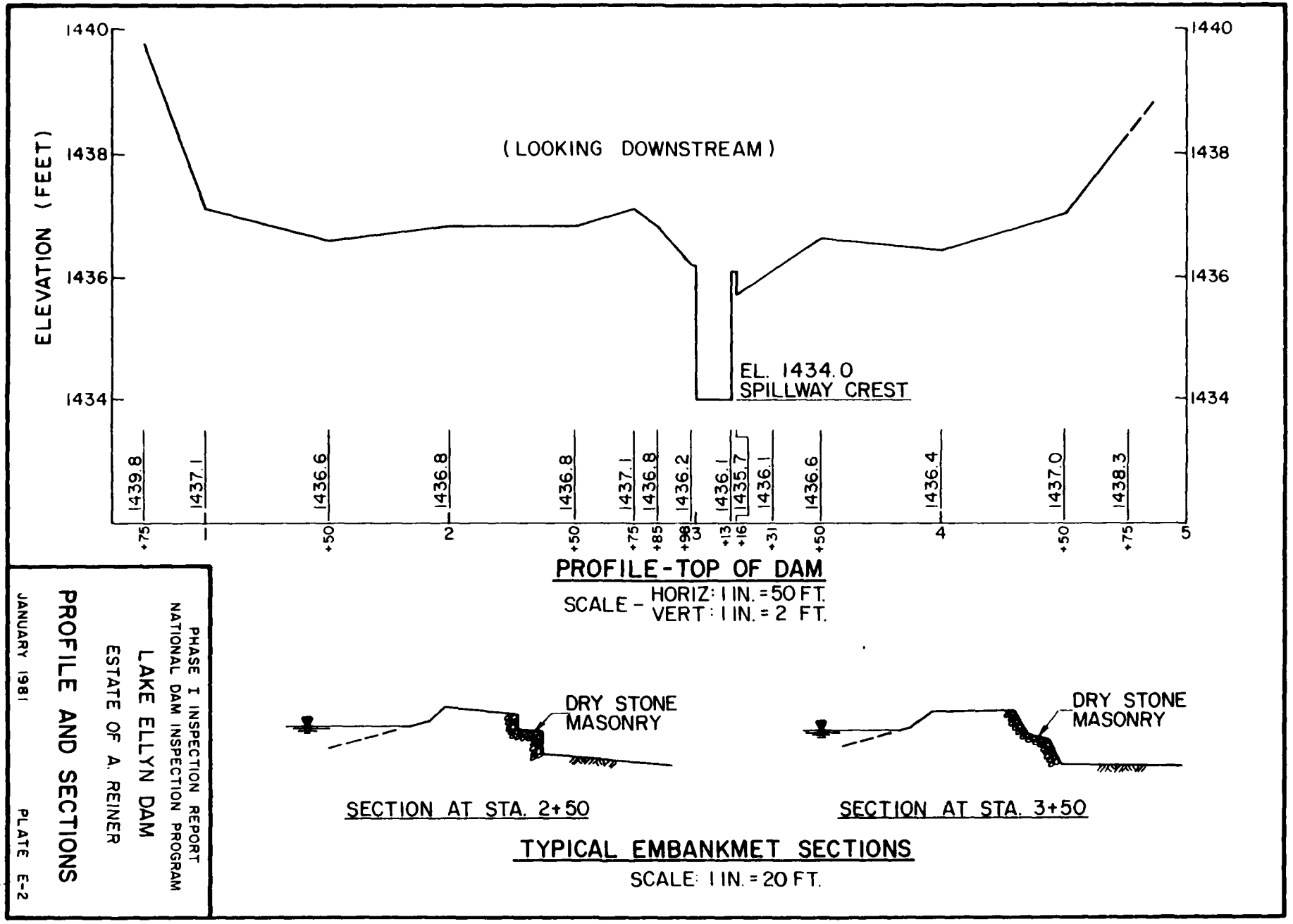
NATIONAL DAM INSPECTION PROGRAM

LAKE ELLYN DAM

ESTATE OF A. REINER

LOCATION MAP

JANUARY 1981 PLATE E-1



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAKE ELLYN DAM

ESTATE OF A. REINER

PROFILE AND SECTIONS

JANUARY 1981

PLATE E-2

APPENDIX F

GEOLOGY

LAKE ELLYN DAM

APPENDIX F

GEOLOGY

Lake Ellyn Dam is located in Wayne County within the Appalachian Plateau Physiographic Province. The most pronounced topographic feature in the area is Camelback Mountain, which is part of the Pocono Plateau Escarpment. The escarpment has a well-defined southwestward trend from Camelback Mountain, but is irregular between Camelback Mountain and Mt. Pocono, which lies to the north. Streams east of the escarpment drain directly to the Delaware River, while those to the west drain to the Lehigh River.

The Pocono Plateau Section lies to the west of the escarpment. This area is relatively flat, with local relief seldom exceeding 100 feet. The topography has been greatly influenced by continental glaciation. Many features were created by deposition of glacial materials. The entire plateau lacks well-developed drainage.

East of the escarpment is the Glaciated Low Plateaus Section of the province. This area is characterized by preglacial erosional topography with locally thick glacial deposits. Local relief is generally 100 to 300 feet.

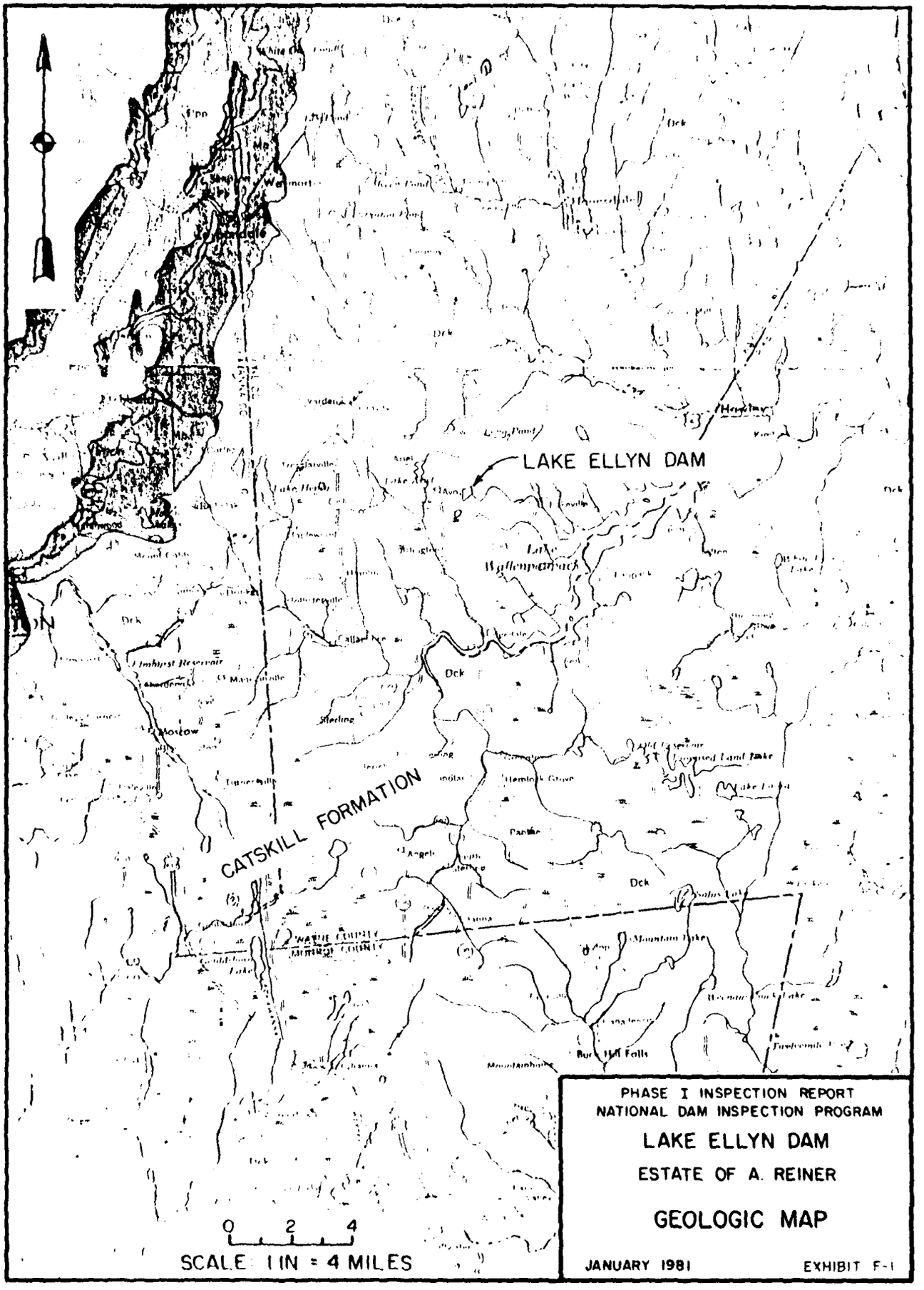
Bedrock units of the sections described above are the lithified sediments of offshore marine, marginal marine, deltaic environments and fluvial environments associated with the Devonian Period. These units include siltstones of the Mahantango Formation, siltstones and shales of the Trimmers Rock Formation, and seven mapped members of the Catskill Formation. These members include sandstones, siltstones, and shales of the Towamensing Member; sandstone, siltstone and shale of the Walcksville Member; sandstones, siltstones and shale of the Beaverdam Run Member; sandstone and shale in the Long Run Member; sandstones and conglomerates in the Packerton Member; sandstones and some conglomerates in the Poplar Gap Member; and sandstones and conglomerates in the Duncannon Member.

Lake Ellyn Dam is underlain by the Poplar Gap Member of the Catskill Formation. The Poplar Gap Member is predominantly a gray sandstone and conglomeratic sandstone with interbedded siltstones and shales. Sandstones present are thick-bedded, fine- to coarse-grained and exhibit very low primary porosity due to a clay and silica matrix. Effective porosity results from fractures and parting planes.

Conglomeratic sandstone occurs primarily as concentrates of subround to round quartz pebbles. The siltstones and shales at the site are thin-bedded and also have low porosity.

The rocks are well-indurated and generally are not susceptible to slope failure; however, the presence of well-developed bedding and joint planes will result in some rockfall from vertical and high-angle cut slopes.

Bedrock is entirely overlain by glacial till of Late Wisconsin Age. This till is an unsorted mixture of clay, silt, sand, and gravel. It is moderately cohesive and is generally derived locally from the sandstones of the Catskill Formation. Thickness of the till varies from 5 to 75 feet.



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NATIONAL DAM INSPECTION PROGRAM

LAKE ELLYN DAM

ESTATE OF A. REINER

GEOLOGIC MAP

JANUARY 1981 EXHIBIT F-1

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